THE PRESERVATION OF WOOD

Creolignum

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Published in the interests of
forest conservation by

THE RODD COMPANY
CENTURY BUILDING PITTSBURGH, PA.

Creosoted wood blocks. When made by Creolignum standards they are absolutely uniform in size and shape and preserved against decay to last for the full life allowed by the traffic which eventually wears them out

FOREWORD

THIS little book is not one of original research. Its data and materials come chiefly from previous publications. But they were in technical language for technical men. This book is for the layman who uses wood. If he has suddenly discovered that his unpreserved wood has decayed, it tells him how he can avoid that replacement bill next time. If he has preserved his wood without consulting the probable mechanical life of his timber, it shows him that a cheaper process might have served his purpose with better economy. If he has doubted even the evidence of his own eyes, in seeing wood supposed to be sound go quietly to powder at unaccountable speed, it tells him how wood if sound in the beginning can be made to remain so up to the limit of its mechanical service.

In this book we have utilized every available source of information and have made every effort at comprehensive treatment and scientific accuracy. The most notable work on the subject is The Preservation of Structural Timber by Howard F. Weiss, pub-

lished by the McGraw-Hill Book Co., New York. For the permission of the author and the publisher to use some of its material, we are glad to record our grateful appreciation.

But this little book wishes to do more than to inform the layman who buys and uses wood how he may best serve his individual interests. It wishes to make him realize what every scientist and engineer has long since realized acutely—the national necessity of protecting his wood against the attack of its enemies. His desire to cut down replacement to a minimum is also one of the most vital needs of his country. This book wishes to do its bit, and to acquaint him with the opportunity to do his bit, in the great national effort to conserve our resources. By protecting his own wood in the best way for his specific purpose, he is at the same time protecting our forests for the common good of all.

THOMAS RODD, Jr.,
Century Building, Pittsburgh.

The National Need

FOUR thousand years ago an Egyptian coffin-maker built a mummy case of wood. Two years ago a Connecticut manufacturer laid a wooden floor in his mill. The Egyptian coffin, after four thousand years of service, is still in a perfect state of preservation. The Connecticut mill floor after two years of service under a light load, has rotted so badly that nineteen floor beams have had to be removed. The Egyptian coffin-maker protected his wooden coffin from the attacks of its enemies. Then he placed it in a stone sarcophagus and interred it in a dry warm tomb free from atmospheric changes. The Connecticut manufacturer did nothing to preserve his floor. The wood was not carefully inspected before it was placed in the building and was probably infected with a contagious wood disease. For two years it was exposed to a state of high relative humidity which fostered the growth of fungi. And at the end of that time his floor was gone.

Four thousand years of service.

In these days of steel and concrete construction, we have come to look upon wood

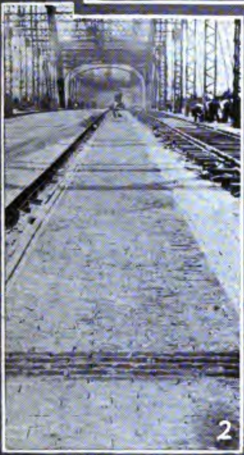
First cost or eventual cost? The wise buyer chooses Creolignum.

Wood is durable.

as something flimsy, something temporary, something cheap. When we build for permanence, we naturally turn away from wood and employ materials seemingly more substantial and durable. Yet there are many conditions in which wood, properly preserved, will outlast steel; for steel has its enemies too, against which it cannot always be as well fortified as wood. Steel is subject to attack from fumes of sulphur and other chemicals that materially shorten its life. In the City of Pittsburgh, steel bridges and buildings are frequently eaten away by the fumes to be found in the smoke that often settles over the city; and the preserved wood of the bridge floors actually requires less attention and gives promise of longer life than the structural steel itself.

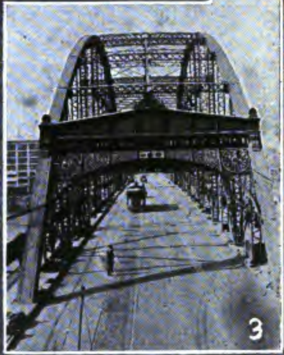
Wood is not limited to temporary use. Its life can be prolonged almost indefinitely. The roof beams of basilicas at Rome have been in service for more than a thousand years in a place where they have been kept perpetually dry. Constant dryness is a condition which the enemies of wood cannot stand. So, too, under most circumstances is constant wetness. In deep-shaft boring for engineering structures, logs have been brought up to the surface in a state of perfect preservation. These logs date back to the glacial period and are about as old as

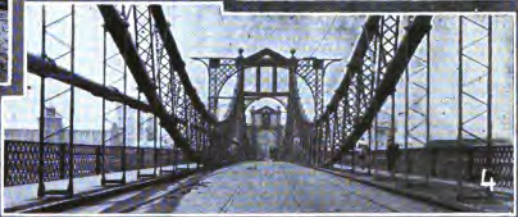
Extreme antiquity of some wood.

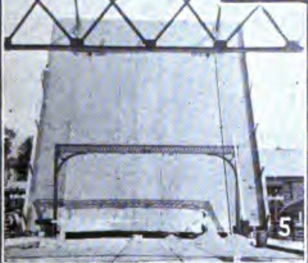


1.—A bridge floor of creosoted wood blocks

2.—Laying the blocks on a bridge floor







3 and 4.—Bridges where the creosoted wood blocks of the floor give promise of longer life and require less care and attention than the structural steel of the bridge itself

5.—A creosoted wood block floor on a lift bridge

anything can be. They have been lying in wet earth which protected them from the attack of fungi, insects and other enemies. In the early days of Christianity, Charlemagne built a bridge across the Rhine, and specimens from that bridge are still in good condition. Constant wetness disheartens the enemies of wood (unless they are marine-borers!) as well as constant dryness; and when wood is protected against the attack of its enemies by natural or by artificial conditions, it will last long enough for almost any human purpose.

A comparison in the life of pilings.

There is a bridge in London whose pilings, constantly under the water, have remained in perfect condition over six hundred years. There is a dock in Texas whose pilings last twenty-nine days. The Thames is free from that most dangerous enemy of wood, the marine-borer. The Gulf of Mexico is literally alive with marine-borers. The London piling survives because these enemies of wood cannot live in water that constantly surrounds it. The Texas piling was destroyed because, surrounded by these enemies of wood, it had not been protected against their attack.

If the wood you wish to use in construction can be kept perpetually immersed in water where marine-borers do not exist, or if it can be kept perpetually dry, you need

no artificial protection for it. If it is sound in the beginning, the chances are that it will remain so for an indefinite period. But unfortunately such conditions are infrequent among our innumerable uses for structural timber. Even bridge and dock pilings, where not subject to the attack of marine-borers, usually wear out at the point between high water and low. With the vast majority of our construction we must face alternately wet and dry conditions. It is under these conditions, favorable to the welfare of its enemies, that wood fails. And so alarmingly has it failed under these conditions that, as wood or labor or the structure grew more costly, it was seen to be a vital need to preserve wood and to protect it from the attack of these enemies.

Beginnings of wood preservation.

At one time the destruction of the ships of the English Navy by dry-rot, decay, and marine-borers became so great that it took on the aspect of a national calamity. It was then that England began the study of the preservation of wood. About the same time Holland was facing an equally important question in the preservation of her dikes. Largely built and supported by wood which decayed rapidly, these dikes began to require so much repair that the deforestation of Holland was threatened. So that

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To make plumbing repairs or to install new machinery, just tear up a few blocks of Creolignum. It is not "monolithic."

country, too, began the study of wood preservation.

The American development.

In America as in England and Holland, the development of wood preservation came tardily and as a distinct necessity. But it proved a greater necessity, when the need was finally appreciated, by reason of the unparalleled rapidity with which the country and its business had expanded. Originally, wood was wasted here in a manner which by present standards seems criminal. Yet it had all been natural enough. Forests had to be cut down for farm and pasture land. New houses had to be built, new communities developed; new populations kept arriving, and the old populations kept pushing westward for elbow room. Then when our civilization was quickened first by steam and afterwards by electricity, the country began to develop at a perfectly prodigious rate. It needed railroads and got them regardless of cost; it needed houses and built them with all thought for speed and no thought for permanence; it needed mills, barns, fences, telegraph poles, factories, and a thousand and one other items made necessary to a rapidly growing and thriving people. All this meant a stupendous demand for wood. Of this there seemed an inexhaustible supply. Even fifty years ago the waste was not very apparent, for

Prodigal destruction of wood.

waste is not perceived in the erection of new structures. It is only when hastily built structures are wearing out and replacement begins that waste is apparent. When America first began to grow, very little wood was required for replacement purposes; but when the demand for wood was no longer chiefly for new construction, then people came to see how prodigal they had been with wood. As the population of the country began to catch up with its enormous natural resources, they awoke to the fact that they had been too wasteful in the past and that their methods of lumbering had meant future impoverishment. The big trees had been cut down and no attempt had been made at reforestation, no trees had anywhere been planted to take the place of those that had been destroyed.

Then we awoke to the danger.

The disastrous results of early waste.

We cannot blame our forbears of fifty years ago for their waste. They were face to face with the urgency of immediate development. They had necessarily an eye only for quick results. Their seeming necessity in a country that was growing so rapidly was to build at once, with little thought for the coming generations. We can now see with new eyes what harm they did. Hills and mountains had been scraped bare with disastrous results. On a level plain

Workmen like Creolignum floors—clean, sanitary, easy on the feet.

For fine residence streets such as this there is no paving so suitable as Creolignum Wood Blocks. Properly laid, they form a surface supremely smooth and quiet, and one which is exceptionally free from the annoyance of frequent repairs

trees are not necessary to hold the soil in place, but on a hillside the case is different. Hills need forest cover. When the trees are gone, the soil is readily washed away by the rain, with the result that bare rock and gravel are all that remain; and bare rock and gravel will not hold water. The inevitable result of the destruction of forest cover on our mountain watersheds is that these great natural reservoirs instead of surrendering their water in rivulets almost constant in size no matter what the season, give up their water as soon as it falls upon them. This water rushes down the mountains in devastating freshets and floods that pile up every year an appalling loss. Scarcely a spring goes by but we read the harrowing story of floods in the Ohio Valley—caused by the wholesale cutting down of trees in the Appalachian Mountains years and years ago. Nor is flood the only damage. In a country denuded of trees, cyclones get their start; and the destruction caused by cyclones every year is exceeded only by that of flood and of fire.

The need for forest cover.

Floods and cyclones.

The need for the preservation of our forests brought about the institution of the United States Forest Service. By the introduction of better lumbering methods, by taking steps compelling reforestation, by guarding against the needless waste of for-

The U. S. Forest Service.

est fires, and by the constant research of its scientists, the Forest Service has gone a long way toward the conservation of our forests that yet remain. This was the serious problem which the Government had to solve and it was solved by the regulations imposed by the Forest Service. But the Forest Service has not been able to decrease materially the amount of wood required for replacement. In spite of all our building, by far the greatest quantity of wood used today is not for original structures but for replacement. How to keep down this necessary replacement to a minimum? That is the problem not of the Government but of the people of the United States. And it is to be solved not by regulation but by education.

A national defect.

In the past we have built so ephemerally, so hastily, with an eye only to present profit and little thought of future necessity, that our need of lumber for replacement is now enormous. During the war an officer of the French Mission while traveling through one of our principal cities exclaimed, "I have never seen such frail houses! One single bomb in an air raid would do untold damage. The very concussion of the explosion would knock down such flimsy structures as these. America does not build for the

century as does France." It is time now for America to begin to build for the century. It is time for Americans to find out that it pays to do so.

Which calls for a national remedy.

This is not merely a matter of individual economy. It is a problem of national magnitude. Somehow, by some method, we must decrease our consumption of wood; we must conserve our forest resources. We cannot accomplish this by restricting the use of wood for new purposes without interfering very materially with national progress. But we can curtail the use of wood for replacement. We can do this by giving every piece of structural timber a longer life of service.

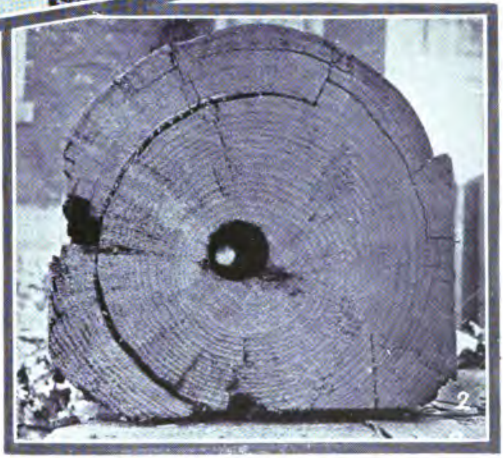
How Europe solved her forest problem.

Europe has faced the same problem which we are now called upon to meet, and she has grappled with it successfully. In spite of the fact that new buildings and new structures of all sorts have called for a greatly increased amount of wood, the quantity used for replacement purposes has been so lessened by wood-preservation that the total drain on the forests has rapidly decreased and their future is now assured. Our need for conserving the forest supply is much greater than was hers. For we were more reckless in our lumbering than she ever was. In the past, too, we built far less substantially; and in the present we are building

vastly more new structures. In face of this constantly increasing need of timber for new and old structures, we can solve our problem of conserving the forests only in the same manner as Europe did—by the preservation of wood. By insuring to every piece of structural timber the longest life that is possible to its mechanical service.

The need for antiseptic treatment.

Timber for the vast majority of mechanical uses is not durable without antiseptic treatment. With such treatment it will last indefinitely or until the mechanical conditions of its service alone have worn it out. It is our desire to impress upon the public in general the national necessity for making wood durable. With this end in view this little book is being published.



1.—A fungus plant that has eaten away the end of a mill beam

2.—A giant loblolly pine column badly rotted after three years' service in a cotton factory

Reproduced from "Dry Rot in Factory Timber."
By permission of Inspection Department of the Associated Factory Mutual Fire Insurance Companies

The Enemies of Wood

FOR the failure of wood there are in general five large underlying causes. They are decay, insects, marine-borers, mechanical abrasion, and fire. Each one of these causes of failure may be guarded against by proper preservation.

Five causes for the failure of wood.

Decay is a germ disease. If you can keep the germ out, or destroy it in time, you prevent decay. A perfect mammoth was found frozen in the ice in Siberia. Its body would have decayed many thousands of years before the Christian era had the ice not excluded the germs. Decay in wood comes from two causes, fungi and bacteria. Both are parasites which live on the wood. The chief cause of decay is fungi. These, as a rule, are of two sorts. The first is mushroom-like and usually is not very destructive. The second is semi-circular in shape and is of a tough, corky substance. This is frequently highly destructive. Fungi reproduce rapidly in two ways; first, sexually through pores in the same manner as ferns, mosses, and the like; second, asexually through roots, which spread very rapidly. The process of decay once begun moves very swifty until the wood is thoroughly rotted. Decay is not a chemical action like

Decay—a germ disease.

the rusting of iron. It is a direct attack upon the substance of the wood by these plants which feed upon it.

How fungi feed and reproduce.

When fungi feed upon wood, they burrow into it. If you were to take off a fungus from a timber upon which it is growing and study the mark that is made there, you would find a bright clean new outline of the fungus itself, but in a short time after exposure to the air, it would turn brown, dry, and powdery, and would lose all its strength and substance. A single fungus produces many millions of spores, which are carried a long distance in the air, and wherever they find lumber they fix themselves upon it and develop new growths. A single diseased beam may rot the wood in an entire lumber-yard. This is especially true of the wood near the ground where lumber is stacked high. As a consequence, many lumber-yards are putting in concrete supports for the piles of timber. Fungi thrive best in a place where the humidity or moisture content of the air at any temperature is high as compared with the humidity required for saturation at that temperature.

Danger in high relative humidity.

This dry-rot, as it is sometimes called, attacks very vigorously the floor beams and the roof beams of cotton mills, worsted mills, paper mills, and the like, where the temperature is kept down but moisture is

not. The lumber never has a chance to dry out thoroughly, and it is in half dampness of this sort that fungi flourish and reproduce most rapidly. Railroad ties that run along swampy ground decay very much more rapidly than ties that are laid across a desert. Masts decay at the deck-line or just below it, where the accumulated moisture from rain and spray leaks down into the deck and is caught there. The Greeks and Romans used stone bases and capitals for their wooden pillars to protect them from the decay that set in around the damper base and under the roof. Many people make the mistake of partially preserving the wood after decay has set in. To paint a timber whose interior has been severely attacked by fungi, or to give it a mere surface treatment of creosote or some other preservative, is to invite trouble; for not only does it lend a sound appearance to an unsound piece of timber, but the surface preservation keeps the moisture in and thereby accelerates the decay. There is only one way to fight decay. First, examine all timber thoroughly to see whether or not there is a serious infection. Second, treat the wood thoroughly by impregnation process with some good preservative, preferably creosote oil. Any engineer will tell you that it is not always possible

How half-dampness fosters decay.

A method of preservation that invites trouble.

Railroad ties treated under Creolignum standards will give the longest service.

to detect incipient decay, and that the only absolute safety is impregnation.

It has been estimated that the annual loss from insects boring into and destroying sound timber is about $100,000,000.

Insects.

There are chiefly three types of insects that attack timber—round-headed borers, timber worms, and ambrosia beetles. They seem to delight particularly in attacking wood with its bark on. You will recall the curious winding holes that they make in log cabins and rustic furniture. Precisely these holes are made in larger and more important pieces of timber and they not only weaken the wood, sometimes very seriously, but lay it open to attack from moisture and from fungi. One of the most destructive insects is called the Powder Post. These little creatures have a perfect passion for telegraph poles. They work their way along the ground until they find a nice, sound, healthy pole; then they bore their way into the heart of it. The interior of a telegraph pole is a fine dry, safe place in which to lay their eggs; so they lay them—thousands of them. Finally the eggs hatch and each little larva feeds upon the timber. Each larva bores a long tunnel in a different direction from his brothers and when he has grown sufficiently fat on the sound wood of the telegraph pole, he lies down and sleeps

The Powder Post Insect.

Zones of quiet paved with creosoted wood blocks

1.—Zone of quiet near a church

2.—Pavement in front of Cincinnati General Hospital

3.—Near the Avondale High School, Cincinnati

awhile in the shape of a pupa. After a time, he knocks off his outer shell and graduates as a fully grown insect. Then he bores his way out again through the wood of the pole into the sunshine. In the meantime, his brother bugs have been doing the same thing; and when the family has grown up, the telegraph pole is riddled with their galleries. It would not be so bad if it stopped there; but these now mature insects come back to the pole to lay their eggs. Two or three generations of this activity will completely powder any telegraph pole or other piece of timber. The Pole Borer is another insect of equally destructive propensities. About the only difference is that the adult beetle lays its eggs on the outer layer of the wood and the larva when it is hatched bores into the center. Altogether the appetite of these land borers is hugely destructive, and the best protection against them is by treating the wood to render it unpalatable to the insects. This is done by a wood preservative in the same manner in which wood is preserved against decay.

The Pole Borer.

The piling of docks, break-waters, bridges, and the like, and the timbers of ships are open to the attack of three types of ship-worms called the Xylotrya, Nausitoria, and Teredo. These ship-worms sometimes grow to be as much as six feet long. Usually,

Ship-worms.

however, they are only about five inches long. A single worm will live for many years. They are terribly destructive. In general, these marine borers live in warm water. They are to be found largely in the Atlantic Ocean from the Chesapeake Bay south, and on the whole Pacific Coast. They reproduce very rapidly. A boat-load of them can appear apparently from nowhere in a single night. They need real sea-water and cannot survive brackish, fresh or turbid water. On the Pacific Coast they are so destructive that the life of an average pile is about one to three years. A single worm will live for many years.

Creosote—the only preservative effective against ship worms.

Marine borers absolutely riddle the timber which they attack; and where they abound, it is almost impossible to get a wood preservative that is effective against them. The best preservative is creosote oil heavily forced into the piling. Large quantities of the oil must be used, however (from 18 to 24 pounds per cubic foot), as it is necessary to inject every cell of the wood very heavily with the oil in order to withstand the attacks of the borers. Creosote oil is practically the only preservative that can be used for protection against marine borers inasmuch as it is the only preservative that is not soluble in water.

Just what part of all the wood in use is

destroyed by mechanical abrasion is very difficult to estimate. It is probably the cause of the loss of most mine props. Although decay here is very active, nevertheless the "squeeze" of the earth is much more destructive. As for railroad ties, it is estimated that at least fifteen per cent. are destroyed by the cut of the rails under the weight of the passing trains.

Mechanical abrasion.

Railroad ties can be very considerably protected from mechanical abrasion by fairly simple means. Tie-plates can be used which absorb the grinding action of the rail and distribute the weight of the train over a larger surface of the tie; holes can be drilled and spikes employed which will follow the holes exactly; spikes instead of being driven can be machine-screwed as is the practice in Europe; S-irons can be used to prevent the spreading of cracks and checks. Yet, decay apart, all these devices will but defer the day when the tie must eventually fail through mechanical wear and tear. No railroad tie can escape wearing out in service.

Tie-plates, screw-spikes and S-irons.

Loss through mechanical failure and loss through decay are, however, very closely united. When a piece of timber has started to decay, it is very easily destroyed by mechanical action which would not affect a sound piece of timber. Conditions of decay that would not affect ordinary timber be-

The relation between decay and abrasion.

come very active when that timber has been scarred by some mechanical means. A railroad tie treated with a medium impregnation of creosote will resist all decay. If, however, the track hand is careless in driving the spikes and splits the tie, permitting moisture to collect in the crack below the coating of creosote, the decay of that tie is very rapid. Therefore it will be apparent at once that if any timber is subject to mechanical abrasion or splitting, its impregnation with a preservative must be thorough and complete and must reach well into the wood. Otherwise the abrasion would lay bare the unpreserved center, and the superficial treating of the outer portions of the wood would become a danger rather than a protection inasmuch as it would keep in the moisture and would hasten decay.

The wastefulness of over-preservation.

It will also be apparent at once, from this illustration of railroad ties, that it is not sound economy to preserve wood beyond the life allowed it by mechanical causes. If because of conditions of service, a certain tie is bound to go to pieces in ten years, preserving that tie for twenty or thirty years is obvious waste. But the science of creosoting has been developed to such a point that it is possible to preserve wood for a fairly definite length of time by some one of the processes to be discussed

1.—Creosoted ties. Note the S-irons that prevent the spread of checking

2.—Creosoted ties beneath the rails and piled along the rightway

3.—Untreated ties piled for seasoning before treatment

later. Therefore care should be taken to determine as accurately as possible, first, what is the mechanical life which can possibly be obtained from any piece of timber. That determined, it is easy then to protect the timber against decay, insects or marine borers, as the case may be. This is a problem of engineering and preserved timber should be engineered for the special purpose for which it is to be applied. It is not wisdom or economy to buy it ready-made or to conclude that specifications which result in properly preserved wood for one purpose are right for another condition or situation.

Loss from fire.

Loss from fire is the great American shame. It has been estimated that the annual loss in the United States is $215,000,000. Our national awakening to this needless and preventable destruction was as tardy as the national awakening to our needless and preventable consumption of wood in other ways. The efforts that are now being made at fire prevention, the use of sprinkler systems, extinguishers, and non-inflammable roofs, have gone a long way toward keeping this figure from mounting much higher.

One cannot render wood fire-proof without destroying so many of its virtues that for general building purposes it becomes im-

Excessive preservation is waste—of a different kind perhaps—but waste just the same.

practical; and the use of an inflammatory material to preserve it would certainly seem offhand to increase the danger from fire. Nevertheless, the case is just the contrary. A wood preservative affords both an indirect and a direct protection against the enemy of wood least to be guarded against by human ingenuity because the one most assisted by human heedlessness. There is a close relationship between fire and decay. Decay in wood ignites more quickly and burns more readily than sound timber. There could be no more emphatic testimony to this than was provided by the Associated Factory Mutual Fire Insurance Companies in a book published in 1915. They warned their members against decay and made a very significant statement. For fifty years, they say, they have been sponsors for the slow-burning or mill construction flooring. These floors are made of heavy timbers set up edge-wise and spiked together. The reason they burn very slowly is because only the surface can catch fire, and they are so tightly laminated together that they exclude oxygen. Yet what is gained in one way the insurance people find is lost in another. "The economy and integrity of this excellent type of building is threatened by the remarkable increase of the prevalence of

Decay—the handmaiden of fire.

An authoritative warning against "mill construction."

Decay is more dangerous and more costly than fire. Resist it with Creolignum.

dry-rot during the last few years. Wood infected by dry-rot ignites more easily than sound wood, and mill timbers with rotted ends fall more quickly under fire." These fire experts, then, go so far as to imply that the danger from decay after fire is started so nearly equals the danger from fire in the first instance that it becomes a toss-up to decide which should be the more guarded against. It is the slow burning mill construction contrived as a protection against fire that invites and forces the spread of decay. Decay-proof and almost equally fire resistant, treated timber becomes more "slow-burning" than untreated mill construction with the danger of decay ever present.

How Creosote becomes a fire-retardant.

This construction is "slow-burning" because the air is excluded. When wood is injected with creosote, the air is likewise excluded because the creosote has filled up all the cells of the wood; and thus the timber becomes about equally fire-resistant. Wood freshly creosoted, it is true, ignites more easily than untreated sound wood; but wood that has undergone the correct creosoted treatment for the purpose, and has been air-seasoned afterwards, ignites less easily than untreated sound wood, and when finally ignited burns far more slowly. The surface

does not catch as easily, and when it does catch, the creosote in the wood acts precisely as oil does in a wick—it burns for a long time without consuming its container. There could be no more emphatic testimony to these two surprising facts than that provided by the Jacksonville fire. Creosoted telephone poles were found standing in good condition when all the buildings around them were smouldering heaps; and creosoted docks were found to be still in flames (and the flames were easily extinguished) when their untreated next-neighbors had been entirely destroyed. The reason fire is more easily extinguished in creosoted than untreated timber is because it nibbles out all the oil with which the wood is impregnated before it devours the solid timber.

Like oil in a wick.

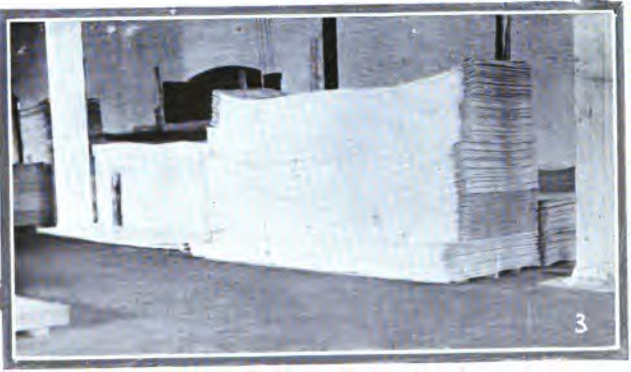
The Creosote poles in the Jacksonville fire.

These, then, are the five chief causes of the failure of wood—decay, insects, marine borers, mechanical abrasion, and fire. They may be all guarded against by the use of an effective wood preservative. Creosoting timber will absolutely prevent the attack of the first two of these enemies—decay and insects; it will enable timber to resist, in varying degrees, the remaining three of its enemies whenever they are present. It greatly prolongs the life of wood exposed to

Creosote—the most useful remedy in all cases.

There is small economy in floors that "outlast" the factory.

1, 2 and 3.—Creosoted wood block floors in the Follansbee Tin Plate Co., Follansbee, W. Va. These floors must withstand the wear and tear of heavy trucking



marine borers; it makes wood more resistant of mechanical abrasion; it makes wood as resistant of fire as any other expedient yet invented which protects without harmful results. No treatment can defy permanently the last three of these ravagers; but the first two can be absolutely prevented, and these render the attacks of the last two more fatal. For these enemies of wood are allies and play into each others' hands. The destruction caused by insects, by marine borers, by mechanical abrasion lays the way open to attack from fungi and the bacteria we call decay; and decay increases the destruction of mechanical abrasion and fire. In human disease an ounce of prevention is said to be worth more than a pound of cure; and when there is no cure for a disease, prevention is all the more valuable. Decay is not the root of all evil in wood, but, deadly in itself, it multiplies the danger of all the others. When the bodily health is broken down, the body is more exposed to assault from without; when decay has begun in timber, mechanical abrasion and fire more easily gain a foothold and their ravages are more rapid and complete. It is safe to say, then, that impregnation with creosote oil is the most important prevention against all the enemies of wood.

The most important prevention.

Creolignum creosoted yellow pine cross arms will resist decay indefinitely.

How Wood Is Preserved

WOOD preservation may be divided into two general classes. These are superficial preservation and impregnation preservation.

Superficial preservation.

Superficial preservation protects the surface of the wood only. It does not get down into the interior. Yet in some situations superficial treatment is the only practical kind, since it is all that is necessary. But before such treatment is decided upon, it is of utmost importance to determine two things. First, is the wood sound? Timber that has incipient decay on the inside should not be used at all, in cases where labor and renewal have any economic value whatever, and certainly it should never receive superficial protection. Decay once started inside goes on at a much accelerated pace since the superficial protection prevents the timber from drying out. Second, will the wood when in use be free from mechanical abrasion? If not, superficial treatment is wasteful. It protects the outside only, and as

soon as the protected layer is worn through, decay will begin. If wood is sound and not exposed to abrasion, superficial treatment is both inexpensive and useful. In general, there are three kinds; charring, brush treatment and dipping.

Charring.

Perhaps the oldest of preservation methods is charring. If we go back to early classical days, we find that the Greeks and Romans charred their structural timber to stave off decay. Fungi do not attack charcoal, and timber coated for one-eighth to one-half an inch with a cylinder of its own charcoal will resist attack to a certain extent. Charring is not much protection, however, and it very materially weakens the wood. If wood to be charred is not first seasoned thoroughly, it is very likely to check. In that case the charring is useless.

Brush treatment.

Brush treatment is somewhat more effective than charring and, although a trifle more expensive, affords a cheap and easy method of protection. The preservative is applied with a brush just as one would paint. Any preservative may be used. A wood-preserving oil is the best, but paint or kalsomine serves its purpose well. Wood that is to be brush-treated should be thoroughly seasoned, as green wood cannot be protected by such a method. The wood

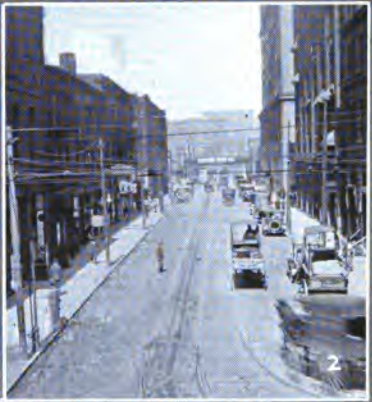
must be dry; it must not be frozen; and care must be taken to cover every check and crack. If creosote oil is used (and it is the best for brush treating), it should be heated to 180 to 200 degrees Fahrenheit for better penetration.

Dipping.

Dipping is the best of all superficial treatments. In no other way can you be sure of covering the entire surface, getting down into all the cracks and wrinkles. But dipping is subject to great handicaps. In the first place, it is very hard to get a tank large enough to dip the telegraph poles and other timbers that are usually given superficial treatment. But where such a tank is obtainable, it is much better than other surface treatments. If creosote oil is used, it should be heated to the same temperature as for brush treatment. This, however, adds considerably to the expense, as a large part of the oil evaporates.

Impregnation preservation.

Impregnation methods may be distinguished from the superficial methods by the fact that they force the preservative deeply into the wood. Some of them are so efficient that with suitable woods the preservative can be driven into every cell so that even if the surface is cracked or scarred the inside of the wood is just as able to resist decay as the outside. Impregnation is con-



1.—A zone of quiet near a court house where traffic is heavy. Creosoted wood blocks were used

2.—Because Creolignum Wood Blocks wear so well and because they are so smooth and quiet, they are used in streets like this.

3.—Creosoted wood block paving in business street under heavy concentrated traffic

siderably more expensive than any of the superficial treatments, but it is so much more effective that in most cases where wood is subject to the attack of any of its enemies the impregnation processes must be used to obtain satisfactory results.

Pressure and non-pressure methods.

In the main, there are in general use two methods of impregnation: a process which operates at high pressure and forces the preservative deeply into the wood, and a process which operates at atmospheric pressure only. There are three preservatives in general use: zinc chloride, mercuric chloride, and creosote oil. Zinc chloride and mercuric chloride are not adaptable to every use, as they are salts soluble in water, and of no value in swampy land, for marine purposes, etc. Mercuric chloride has an additional drawback. It is very dangerous when used in situations where it can be licked by cattle and other animals. After wood preserved by mercuric chloride has been in service for a time, the preservative leaches out and forms in crystals over the surface. These crystals are deadly poison and are very attractive to animals.

Three Preservatives.

The three processes in general use that do not depend chiefly upon creosote are the Burnettizing process, the Card process, and the Kyanizing process.

Buy enough preservation to be economical, but not so much as to be extravagant. Creolignum is made to order.

Burnettizing. Burnettizing or zinc chloride process impregnates the timber with a water solution of zinc chloride under pressure. Zinc chloride is ordinarily a cheap and fairly strong preservative. It is a good method for preserving railroad ties where the mechanical life is limited to only about twelve years.

The Card Process. The Card process is a pressure treatment very much like Burnettizing. Only instead of using pure zinc chloride, it mixes the zinc chloride with creosote oil. This process is more expensive than Burnettizing, but cheaper than pure creosote processes, inasmuch as creosote oil costs more than zinc chloride. It is not so strong as pure creosote oil, however, but where a shorter life is required it is a cheap and effective preservative.

Kyanizing. The Kyanizing process is not used very extensively. It consists of a pressure treatment with mercuric chloride, and is carried on in tanks of solid granite as mercuric chloride is too corrosive for use with steel or iron. It is a very effective preservative, but is very expensive and it has the drawback of using mercuric chloride, which is not only dangerous to animals but is very difficult to handle. The process is long and tedious, as the timber must be steeped under pressure in the solution for a period lasting

There is no reason why a floor should not last as long as the rest of the building.

from three to seven days. Even then but a slight penetration is obtained, as the preservative enters only one-tenth to one-quarter of an inch.

The Creosote Processes.

Creosote oil is the preservative used in the great majority of cases with wood. It should correctly be called tar oil, but commercial usage has given it the name creosote oil. It is the most satisfactory preservative and the one most adaptable to general use. There are today in general commercial use three methods of preserving wood by the use of creosote oil. They are all impregnation processes, and they have arisen from the numerous different problems of wood preservation. They are the Open Tank process, the Bethel or full cell process, and the Rueping or empty cell process.

The Open Tank Process.

The Open Tank method operates at atmospheric pressure only. A bath of hot creosote oil is prepared in an open tank. Beside it is prepared another bath of cold oil. The wood is immersed first in the hot oil. This rarifies it and drives out the air, sap and water. The oil does not penetrate very far when it is heated thus, but when the hot wood is drawn out of this bath and quickly plunged into the other bath of cold creosote, the air in the cells of the wood contracts, sucking in the oil to a very good

penetration. The wood should be seasoned thoroughly first in order to obtain the best results. The depth of the penetration can be controlled very well by regulating the temperature of the tank. In no case should the oil in the hot oil tank ever be allowed to get above 250° Fahrenheit, as it is then likely to injure the wood. The wood should be kept from one to three hours in each bath. The Open Tank method is a fairly effective preserving process. It works very well on large unwieldy timbers, fence posts, and telegraph poles, and is particularly valuable where it is desired to treat part of a pole, as in the butt treatment of telegraph poles. The two drawbacks to this treatment are first that it is very wasteful of creosote oil inasmuch as a large quantity of it evaporates, and second that the penetration, although good, is sometimes not sufficient for complete protection.

The Full Cell Process.

The Bethel or full cell process is one of the best preserving methods. Where green timber is used, it must first have a bath of live steam of several hours in order to open the cells for proper treatment.

The timber is piled into small cars or buggies which run upon tracks into cylinders. These cylinders have a diameter of from 6 to

A knowledge of wood preserving begins with a knowledge of wood. No mere superficial study will qualify a wood preserver.

7 feet and are from 50 to 180 feet in length. When the timber is in place, the cylinder is closed airtight by means of a large circular door, then a vacuum is drawn and held at least one hour. This vacuum draws out all the surplus sap and air in the wood and leaves the cells empty. It might almost be said that the wood resembles a sponge that has been squeezed and is ready to soak up anything with which it comes in contact. Creosote oil is then pumped into the cylinder and a pressure of 100 to 180 pounds is applied. The pressure forces the creosote oil into the cells so that it penetrates thoroughly. Then the excess oil is drained from the cylinder and the timber is allowed to drain. The Full Cell Process is expensive, for it uses a great deal of creosote. It is the chief means of protecting piling against marine-borers, as a large amount of creosote is required to keep them away. It is also efficient for street paving blocks. But for some purposes the oil used in so great quantity leaches out, and this becomes very objectionable, as in interior wood block floors.

The Rueping Process.

For these and for many other uses of preserved timber, the Rueping process is preferred. Leaching or bleeding of oil is practically eliminated, inasmuch as all excess oil is removed. The Rueping Process has

Do not buy wood that is preserved beyond its possible mechanical life.

been called the empty cell process. It differs from the Bethel, in that it is possible to obtain a very deep penetration at a small consumption of oil. The same type of cylindrical tank is used, but the procedure is reversed. The wood is piled into buggies, the buggies are run into the tank, and the tank closed and sealed in much the same way. Then, instead of drawing a vacuum, air is pumped into the tank until the air in the wood cells is compressed. Creosote oil is then admitted into the cylinder and the pressure is increased to about 150 pounds a square inch, forcing the oil deeply into the wood. When that has been accomplished, the pressure is released; and the expansion of the compressed air within the cells expels the surplus creosote from the wood, this expulsion being aided by drawing a vacuum in the tank. By this method, a very deep penetration is obtained and at the same time no oil is wasted. Thus it is very economical, when it is adapted to the purpose required.

The real science of preservation.

This adaptation to the required purpose is the chief point in wood preservation. The preservation of wood is a scientific matter. Every step in the process from living tree to preserved timber must be supervised with

When you buy Creolignum, you build for the future. When we sell Creolignum, we build for the future. We do not dare deliver less than the best.

an eye upon the result required, an eye trained by long experience with all the problems it presents.

The selection of the wood.

In the first place the wood itself must be right. Where long-leaf pine is required, care must be taken to get genuine long-leaf and not short-leaf or loblolly pine. Where these will do, it is wasteful to use long-leaf. Second: for some purposes wood should be cut at a special time of the year. Wood cut in the winter is very different in its nature from wood cut in spring or summer. It is less liable to insect and fungus attack and can be seasoned with much less danger of checking. All wood must be thoroughly peeled of bark before being preserved. A single strip of bark will prevent the injection of the preservative beneath it, and the failure of a whole process of preservation can come from one shred of adhering bark. The limitations of this book prevents us from entering into a discussion of seasoning, but every one knows that wood improperly seasoned may warp and check in service. Seasoning should take place before preservation treatment.

It is not feasible within the limits of this book to describe in detail the various problems that occur in preserving wood with

Difficulties in the way of the wood preserving engineer.

creosote oil. They are many and varied. The wood preserving engineer must take into consideration the nature and quality of the wood. He must understand its structure and the amount of seasoning required. He must know the use to which the wood is to be put after it has been preserved so as to determine the required number of pounds of creosote oil per cubic foot of timber. He should know the extent to which the wood is to be subject to mechanical abrasion, to the attack of insects and marine-borers, and to the presence of other forces inimical to the welfare of the wood. Then, inasmuch as wood preservation is primarily a matter of economy, he must operate his creosoting plant in such a way as to get the greatest possible amount of preservation for the quantity of oil used. He must guard against evaporation and other waste, and at the same time he must give the preservative treatment the wood requires. The many problems of preservation demand the most thorough equipment of experiences. The right process for the particular use in hand should be selected, and should be selected by engineers skilled in wood preserving problems.

Wood is the most workable and the most adaptable material in the world. Properly treated, it can be made to outlast steel or stone.

Saving the Forests Saves You

As long as a country is heavily forested, nobody bothers to save wood. It is when forests are becoming scarce that the government begins to think about saving. Our Government estimates that the efficient application of preserving methods would decrease the drain on our forests by seven billion board feet a year. This amounts to a saving of about $84,000,000 a year. Wood preservation, then, not only spares our forests for the future but is sound capitalization for the present. If you are using your share of wood, why not save your share?

Wood preservation will save our forests. Do your share!

We preserve our steel by paint and our concrete by dressing. We treat everything we use in order to prolong its life of usefulness. Why not preserve our wood with creosote? People have not yet come to regard creosoting as a matter of course. The reason they have not is because it was for so long our national habit to look upon our forests as eternal and our wood as short-lived. We have gone on building out of a supposedly inexhaustible stock and for the present only, saying to ourselves that

The good sense of preservation.

Ask your safety engineer about his floor troubles. He will prescribe Creolignum.

the life of such and such a structure is only just so many years anyhow.

But the science of wood preservation has shown us the supreme folly of such an attitude.

Another economy.

Not only that—by preserving wood for building construction, woods not naturally durable can be made to compete with the more expensive kind and are preferable in that some possess greater strength. When the best in the forests has gone, people have to use second best. This country was very wasteful of its best, but it was also very lucky in not having to take second best until science had found a way to make that durable. The best wood grows scarcer and more expensive every day. Creosoting permits us to use inferior woods which without preserving would be of little or no value. Almost any kind of non-durable wood can by treatment be made into a good post. An inferior wood can sometimes be made even more durable than a more expensive wood. A pine cross arm untreated lives only two-thirds as long as an untreated fir cross arm; but treat them both and the cheaper pine lives one-fifth longer. With antiseptic treatment and reasonable allowance, when required, for difference in strength, the inferior quality is as satisfactory as the more expensive; but without antiseptic treatment it invites disaster.

Giving a new value to inferior wood.

When wood rots, it means far more than the cost of new lumber. It means the cost of labor to take out the rotten piece and put in the sound piece. In structural cases, it means besides the cost of all the materials destroyed and of all those furnished in the taking out and putting in. It often means costly interference with the normal conditions or output of the structure. Thus it is economic waste of the worst type.

Saving labor costs.

Suppose labor cost nothing. Suppose that timber when put into an expensive structure cost no more than timber lying on the ground. Suppose that replacing rotted timber were absolutely no trouble, that it did not cause delays, nor hold up traffic and business. Suppose all this. Even then, it would pay to preserve wood.

In these days of changing prices, we cannot take up specifically the actual costs of untreated and preserved wood and expect this book to be accurate for a month from the day it goes to press. But we can make general statements in regard to the relative price of untreated and preserved timber. In any given case, the Rodd Company will be glad to prove in dollars and cents that preserved timber is more economical than untreated timber. This economy may be

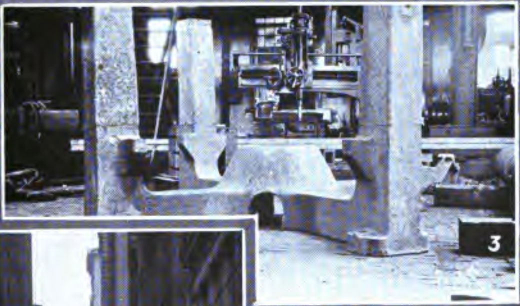
An out-and-out economy in material.

expressed thus. The cost of untreated timber divided by the years of its service is greater than the cost of preserved timber divided by the years of its service. This statement is based on the false supposition that the cost of replacement is zero. But labor is far from costing nothing. The cost of replacement is always in excess of the mere cost of the material used. Suppose an untreated fence post should cost 17 cents. Suppose that same post, fully impregnated with creosote, should cost 33 cents. The initial cost of the creosoted post is nearly double that of the untreated post. But the untreated post lasts 5 years. The creosoted post lasts 21 years. The annual cost of the untreated post is 4 cents. The annual cost of the creosoted post is only 2.8 cents. Such a saving, in a long fence, is very material. But that is the smallest part of it. In the 21 years of life of a creosoted post, four rotted posts would have been pulled out, five holes would have been dug, and five untreated posts would have been placed in the ground—all by labor which costs something.

Initial cost vs. final cost.

Consider for a moment these tables compiled from tables in Howard F. Weiss's book, "The Preservation of Structural Timber."

Creolignum is a trade-marked article, advertised thruout the country, and dependent upon good will for its future. It must conform to specifications, and the specifications must be right.



1.—A floor that will not injure dropped tools or castings

2 and 3.—Typical creosoted wood block floors at the United Engineering and Foundry Co., Pittsburgh

4.—Wood blocks that stand the hammering of constant traffic

Life of Fence Posts

Method of Treatment	Life of Posts in years
Untreated	5
Brush-treated with creosote	9
Dipped in creosote	11
Impregnated with zinc chloride or mercuric chloride	12
Impregnated with creosote	20

Life of Mine Timbers

Method of Treatment	Life of Timbers in years
Untreated	2
Brush-treated with creosote	5
Burnettized (zinc chloride)	10
Rueping Process (empty cell creosote)	11
Bethel Process (full cell creosote)	15

Life of Poles

Method of Treatment (Cedar Poles)	Life of Poles in years
Untreated	14
Charred at butt	15
Butt brush-treated	18
Butt treated with zinc chloride (open tank)	22
Butt treated with mercuric chloride (open tank)	24
Butt treated with creosote (open tank)	30
Bethel process—full cell creosote (pressure)	30

Life of Cross Arms

Method of Treatment	Life of Fir Cross Arms in years	Life of Pine Cross Arms in years
Untreated	15	10
Rueping Process (empty cell)	25	30
Dipping in creosote	20	18

Note: The Bethel process uses too much creosote for cross arms. They become too heavy and are objectionable because the preservative drips from them.

A floor of Creolignum can be laid over any other floor —without seriously interrupting the regular work of the factory.

The following table showing how the life of railroad ties is prolonged by preservation has been compiled from statistics collected by The Rodd Company.

Kind of Wood	Untreated	Burnettized	Life in Years Rueping Process	Bethel Process
White Oak ...	8-10	——	——	——
Beech	3-5	10-12	15-20	20-30
Birch	3-5	10-12	15-20	20-30
Maple	3-5	10-12	15-20	20-30
Red Oak Family	4-6	10-12	15-20	20-30
Heart Pine	6-8	10-12	15	15
Sap Pine	2-3	10-12	15	15-20

Note:—White oak ties have the longest life of any untreated tie. They are very expensive and are becoming scarce. But inasmuch as they resist preservation, they are rarely treated and usually are not protected with plates.

These tables serve to show in a general way how preservation treatments add to the life of wood.

The chief commercial uses.

The chief commercial uses of preserved wood are as follows:

1. Railroad cross-ties.
2. Wood block street paving.
3. Interior wood block factory floors.
4. Poles and piling.
5. Structural timbers for bridges, docks, trestles, abutments, retaining walls.
6. Cross-arms (for telegraph and telephone poles).
7. Wooden conduit.
8. Fence posts.

Every day is bringing to light new uses for preserved wood. Creolignum can be supplied for any purpose, new or old.

The wood preserving industry is expanding at a very healthy rate which indicates that the large consumers of wood who make close study of the relation between initial cost and wearing value realize its economic advantages. Especially are railroad companies and municipalities alive to the sound economy of wood preservation.

STREET PAVING.—The increasing use of wood block street paving is the greatest testimony of its superiority. A wood block pavement is about as durable as a stone block pavement and more durable than any other. It is nearly as smooth as new asphalt and smoother than any other pavement. It is by far the quietest pavement and the easiest to repair and maintain. All the wear comes on the end of the grain and is almost imperceptible. After the Baltimore fire the wood block pavement was intact when the concrete pavement had melted and run off through the gutters.

The finest paving in the world.

FACTORY FLOORING.—Just as wood blocks make the most efficient street paving, so also they make the most desirable floors for many types of factories. But in addition to the qualities that make them good for street paving, it must be noted that for factory use, wood blocks have other qualities

The faultless floor for factory, warehouse or shop.

Consider not the cost of building, but the cost of rebuilding. And figure in the delays and suspension of work.

to recommend them. They are soft and resilient under the feet. They do not injure dropped tools. They are free from annoying dusts. Dust too is sometimes very destructive; the annual damage to paper stock alone in storage and warehouse from the dust of concrete floors is astounding. Wood block floors do not reflect light or heat. They are not monolithic. Any part of such a floor can be ripped out or replaced to make repairs, or install new machinery. The blocks offer a perfect surface for trucking. They may be laid over any concrete floor now in use, with practically no interruption of factory work.

Summary. Summary.—The useful life of any wood that is subject to the attack of its enemies—decay, insects, marine-borers, mechanical abrasion and fire—can be materially increased at a real saving of money. If there were a national consciousness of this economy and if the present appalling waste of lumber for needless replacements were eliminated, our forest problem would be solved.

Our personal contribution towards solving this problem we have called "Creolignum."

Seize upon a strike as an opportunity to make repairs and alterations. A new floor of Creolignum may help prevent strikes.

1.—A three-year-old fence sadly in need of repair. Unpreserved posts were used—an expensive practise in the long run

2.—A ten-year-old fence as sturdy as the day it was built. The creosoted wood posts have long since saved their additional cost

3.—A Creolignum fence post, properly preserved to resist decay. Note the water-shedding top

The Meaning of "Creolignum"

"CREOLIGNUM" is a registered trade name for two things—a material and a service.

The material is wood.

The service is an engineering service that determines the specifications of that wood to suit the special need of the buyer.

Both are supplied by THE RODD COMPANY, Century Building, Pittsburgh, and THE SOUTHERN WOOD PRESERVING CO., Atlanta, Ga.

"Creolignum," then, means preserved wood that is preserved to order.

If you have read this book carefully, it must be evident to you that

First—Wood preserving is an economy.

Second—An economy must operate without waste.

Third—Preserving wood so as to get anything less than the longest life at a given cost is waste.

Fourth—Protecting wood against decay for a longer period than its possible mechanical life, is waste.

Fifth—Preserving wood by a complete, expensive process, when a cheaper process will answer the purpose, is waste.

Sixth—Preserving wood by a method that is dangerous or disagreeable or unsuited to its purpose is worse than waste.

CONCLUSION.—Preserving wood is a scientific job. It must be done in a scientific way. The Creolignum way is the scientific way.

Creolignum is not the result of any one process nor of special manufacturing facilities. The processes differ with each individual case.

You cannot buy Creolignum unless it will serve your purposes better than anything else.

You cannot buy Creolignum unless it is built according to specifications determined by our engineers to suit your particular needs.